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ABSTRACT

The numerous and widespread problems associated with the automobile are discussed. Traffic congestion, air pollution, and oil dependence are some of the reasons why the use of alternative fuels is necessary. A proposal is made for a new transport environment where walking, bicycling, and public transportation are used to complement the use of the automobile. Gradual restructuring of cities and suburbs to make alternatives viable and to lessen the need for driving is also discussed. Chapters include: (1) "From Servant to Master"; (2) "Getting on Track"; (3) "Cities for People"; (4) "The Road Not Taken"; and (5) "A Policy Overhaul." (KR)

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Alternatives to the Automobile: Transport for Livable Cities

Marcia D. Lowe

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Introduction

The automobile once promised a dazzling world of speed, freedom, and convenience, magically conveying people wherever the road would take them. Given these alluring qualities, it is not surprising that people around the world enthusiastically embraced the dream of car ownership. But societies that have built their transport systems around the automobile are now waking up to a much harsher reality. The problems created by overreliance on the car are outweighing its benefits.

These problems are numerous and widespread. Traffic congestion and air pollution plague all major cities, and oil dependence makes economies vulnerable. Metropolises with streets designed for cars instead of people are increasingly unlivable. In developing countries, automobiles serve only a small elite and leave the vast majority with inadequate transport. In Eastern Europe and the Soviet Union, recent reforms could add the problems of automobile dependence to already overwhelming economic and environmental crises.

Improving automotive technology can never completely solve these troubles. Enhanced fuel efficiency and pollution control are at least partly offset by the sheer amount of additional driving, as some 35 million new cars roll off assembly lines each year. Even in the United States, where emissions controls are most effective, air pollution is worsening. And no matter how clean or fuel-efficient automobiles become, they still cause traffic jams. Automobile dominance creates a set of problems so relentless that societies in coming decades will have no choice but to seek transport alternatives.[1]

A new, more rational approach to transportation is needed, one that puts the automobile in its rightful place as one among many options for

I would like to thank Erik Hagerman for research support, and Denise Byers for patient production assistance. I am very grateful to Carrol Carter, Elizabeth Deakin, Ron Kilcoyne, Michael Replogle, Elliott Sclar, and several of my Worldwatch colleagues for reviewing earlier drafts.

travel. Buses and trains are more appropriate than private cars as the centerpieces of transportation systems, particularly in the world's most congested cities. At reasonable occupancy rates, public transport uses space and energy many times more efficiently than cars, and creates much less pollution.

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In this new transport environment, walking and bicycling would also play important roles, complementing public transport with the convenience of individual mobility. These nonmotorized forms of travel have the potential to take on a considerable share of the transportation burden—as long as cities cater to the needs of pedestrians and cyclists. Making transport sustainable depends largely on creating urban space that is not dominated by cars, and safely accommodates public transport, cyclists, and pedestrians.

Making drivers pay more of the true costs of automobile use would hasten the shift to alternatives. For example, drivers would find public transport, cycling, and walking much more appealing if the costs of congestion and air pollution were reflected in the prices for road use, parking, and fuel.

Getting away from automobile dominance also requires gradually restructuring cities and suburbs to make alternatives viable and lessen the need for driving. Future development can be planned to create compact cities in which jobs, homes, and services are consolidated and near public transport. In both industrial and developing countries, careful urban planning can help meet future transportation needs by minimizing the demand for travel.

These suggested changes do not aim to replace the automobile, but rather to complement it with convenient and safe access to public transport, cycling, and walking. If a genuine transport balance is achieved, cities can offer high-quality transport to drivers and nondrivers alike, without sacrificing such amenities as clean air and a livable environment.

Although cities that have maintained their public transport systems and avoided sprawled development during the automobile era are now

"Obeying the demands of the private car has become a passive routine for many of the world's cities."

better positioned to ease their dependence on cars, it is not too late for any city to diversify its system. But creating sustainable transportation requires bold policy moves. However challenging such a shift may be, it is preferable to being caught unprepared by a series of environmental and economic crises in the decades ahead.

From Servant to Master

Perhaps more than any other invention, the automobile embodies author Jacques Ellul's observation of all technologies: it makes a good servant but a bad master. Yet obeying the demands of the private car has become a passive routine for many of the world's cities. Automobile access has dictated the very character of urban life, most obviously in the design of the modern city. Vast roads and parking lots distort cityscapes into proportions that dwarf and intimidate humans. Once all available surface space has been surrendered to private cars, engineers turn to space overhead and underground. In a final gesture of submission, entrepreneurs in Yokohama, Japan, recently opened a floating parking lot in the local bay.[2]

Growth in the world's 400-million-strong auto fleet makes it clear that if societies fail to regain mastery over the automobile, car-related problems will become global crises. (See Table 1.) The average annual rate of growth in car ownership has slowed from 5 percent in the seventies to 3 percent in the eighties because of saturation in the industrial countries, which account for about 80 percent of the global fleet. But while the world fleet is no longer growing as quickly as it did before 1970 (now taking two decades to double instead of one), the absolute number of cars added is huge; currently, a net total of 19 million cars is added to the world fleet each year.[3]

Much faster growth is occurring in the developing countries, which are avidly chasing the dream of car ownership. In the Third World, car ownership grew at an average of 9 percent annually in the seventies, but slowed to 5 percent in the eighties. Although international debt and severe economic troubles have checked auto expansion in developing

Table 1: Passenger Cars in Use Worldwide, 1970–1988

	Soviet Union and Eastern Europe	Developing Countries	Industrial Countries	World
		(million)		
1970	6	13	175	194
1975	12	21	227	260
1980	20	31	270	321
1985	27	41	307	375
1988	34	47	332	413

Source: Worldwatch Institute estimates, based on Motor Vehicle Manufacturers Association, *Facts and Figures* (Detroit, Mich.: various editions).

countries, their fleets are still growing twice as fast as those in industrial countries.[4]

In the Soviet Union and Eastern Europe, growing consumer demand led to a tripling of automobile production in the seventies. The size of the car fleet in this region reached 27 million in 1985, a fivefold increase over 1970. With recent political and economic reforms, these countries now appear poised at the brink of widespread car ownership. Although it is too early to project how quickly auto fleets will expand, it seems inevitable that without deliberate restraints, car ownership will skyrocket. Major companies—including Volkswagen, Suzuki, General Motors, and Fiat—have already unveiled plans for joint ventures in the region.[5]

Along with the increase in the automobile's numbers come ubiquitous problems. Traffic congestion, now a fact of life in the world's major cities, has stretched daily rush hours to 12 hours or longer in Seoul and 14 hours in Rio de Janeiro. In 1989, London traffic broke a record with a 33-mile backup of cars at a near-standstill. The Confederation of British Industry estimates that higher freight transport costs, lost work time, and other results of congestion cost Britain $24 billion each year. Half of U.S. business leaders surveyed in 13 major cities said that traffic condi-

"Passenger cars account for more than 13 percent of the total carbon dioxide emitted from fossil fuels worldwide, or more than 700 million tons of carbon annually."

tions affected their employees' morale, productivity, punctuality, and emotions.[6]

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Motor vehicles are the single largest source of air pollution, creating a haze of smog over the world's cities. The main component of car-induced smog is ozone, a gas formed as nitrogen oxides and hydrocarbons react with sunlight. Ozone and other pollutants—including carbon monoxide, nitrogen oxides, and hydrocarbons—aggravate bronchial and lung disorders and are often deadly to asthmatics, children, and the elderly. Ozone damage is also believed to reduce soybean, cotton, and other crop yields by 5 to 10 percent. Motor vehicles are generally responsible for 30 to 40 percent of nitrogen oxides emissions in cities; these compounds are precursors to acid rain and other forms of acid deposits, which kill life in lakes and streams and are suspected of damaging forests.[7]

The rise in car ownership in developing countries, the Soviet Union, and Eastern Europe threatens to exacerbate already critical air pollution problems in these regions. Third World cities have fewer vehicles than those in industrial countries, but because of inadequate or nonexistent exhaust controls, pollution is far more serious. Soviet and Eastern European cities can ill afford to add significant amounts of motor vehicle exhaust to industrial pollution that is already among the worst in the world.

Automobiles are also a major source of carbon dioxide, the greenhouse gas responsible for over half of the global warming problem. Passenger cars account for more than 13 percent of the total carbon dioxide emitted from fossil fuels worldwide, or more than 700 million tons of carbon annually. This figure is projected to increase 75 percent by the year 2010.[8]

Oil spills are another consequence of heavy auto use. Tanker accidents occur more often than is generally thought—one spill a day afflicts the New York Harbor area alone. More importantly, while accidental spills annually dump an estimated 2.9 million barrels into the sea, roughly six times more oil gets into the oceans simply through routine flushing of carrier tanks, runoff from streets, and other everyday by-products of a

petroleum economy. Though major spills provoke loud cries of outrage, few people question why most of the oil was on the tanker in the first place. But the environmental group Greenpeace made the connection after the Exxon Valdez disaster, running an advertisement with the tanker captain's picture reading: "It wasn't his driving that caused the Alaskan oil spill. It was yours."[9]

The economic and political vulnerability of a car-dependent society becomes painfully clear in the event of an oil crisis. The United States, which uses 43 percent of its petroleum to fuel cars and light trucks and imports half of all its oil, was severely jolted in August 1990 when Iraqi President Saddam Hussein's troops invaded Kuwait, claiming control over nearly 20 percent of the world's proven oil reserves. Even when the current crisis subsides, the Middle East may never again be counted on for a stable supply of oil. Meanwhile, output is falling in non-OPEC countries, particularly in the Soviet Union and the United States, while demand is skyrocketing in the newly industrializing countries of Asia and Eastern Europe. Even in a stable market, increasing reliance on foreign oil weakens the strongest economies and places a crippling burden on developing countries mired in debt.[10]

The enormity of these automobile-related problems defies mere technical fixes. Without alternatives to cars, progress in fuel economy and emissions reduction risks backsliding because of increased driving. In the United States, for example, dramatic reductions in hydrocarbon and carbon monoxide emissions made possible by the catalytic converter have been partly offset by car use, which is now growing by more than 120 billion kilometers each year. In 1989, 96 metropolitan areas, home to more than half of the country's residents, failed to meet the U.S. Environmental Protection Agency's ozone safety standard, and 41 areas violated the carbon monoxide standard.[11]

While some technical changes hold great promise, they don't address all the problems of automobile use. Improving new cars' fuel economy could ease dependence on oil, and together with stricter emissions standards and improved exhaust controls could also reduce air pollution considerably. But these changes do nothing to ease traffic congestion.

"A study of 15 developing countries found that road accidents were second only to intestinal diseases as the leading cause of death."

Even electric cars, which could greatly reduce fossil fuel consumption and pollution, would still contribute to traffic jams.

Moreover, no automobile technology can fully address the negative social consequences of a car-dominated society. Traffic deaths are an example. Despite safety improvements, more than one-quarter of a million people worldwide were killed in road accidents in 1988, and several million more were injured or permanently disabled. The greatest danger of road accidents is in the developing world's dense, chaotic mix of motorized and nonmotorized traffic. Developing countries' fatality rates from road accidents are 20 times those in the industrial world; a study of 15 developing countries found that road accidents were second only to intestinal diseases as the leading cause of death.[12]

In the United States, some 49,000 people died in motor vehicle accidents in 1988—more than all other accidental deaths combined. Road tragedies strike hardest among society's youth. Though the number of children and young adults killed is shocking, it is a crudely inadequate measure of the years of life that are needlessly lost, or of the depth of communities' mourning.[13]

The automobile's reign degrades the quality of life in many cities. Studies show that traffic jams can raise drivers' blood pressure and provoke negative moods and aggressive driving. Perhaps to an even greater extent, the health and safety of people on the street are compromised for the convenience of those behind the wheel. Roaring engines and blaring horns cause distress and hypertension, as in downtown Cairo, where noise levels are 10 times the limit set by health and safety standards. In the 12 countries that make up the European Community, more than one-quarter of the 49,000 people killed in 1987 in road accidents were pedestrians or cyclists. Coexisting with cars is even more dangerous in developing countries, where the vast majority travel on foot or by bicycle.[14]

Finally, no new car technology will serve the majority of humanity who will never own an automobile. A Fiat minicar in China sells for roughly $6,383—a modest sum in wealthy countries, but equal to about 16 years' wages for an ordinary Chinese worker. In much of the develop-

ing world, more car buying only means that a small elite is improving its travel options, while the vast majority's mobility and accessibility are impaired. People in Third World cities have to live with deadly air pollution, congestion, and dangerous and inhospitable streets—yet most will never enjoy the privileges of an automobile.[15]

Even in car-oriented industrial countries, those who either cannot afford a car or are unable to operate one often have no access to jobs, schools, health centers, and other important destinations. Children, the handicapped, the poor, and the elderly are not only made less mobile by an auto-based system, but they also bear the brunt of its costs: the physically weak suffer the most from pollution, and the poor are those most often displaced by roads.

Creating sustainable transport systems that meet people's needs equitably and foster a healthy environment requires putting the automobile back into its useful place as a servant. With a shift in priorities, cars can be part of a broad, balanced system in which public transport, cycling, and walking are all viable options.

Getting on Track

Public transport plays a central role in any efficient urban transport system. In developing countries, where at least 16 cities will have more than 12 million people each by the year 2000, failing to give priority to public transport would be disastrous. But neither the exploding Cairos and Delhis nor the relatively stabilized New Yorks and Londons can sustain future growth in automobile use. As the nineties begin, a new oil crisis, mounting pollution and congestion, and global warming all call for a greater commitment to public transport.[16]

Public transport comprises many different types of vehicles, but most commonly the term refers to buses and trains. Buses take many forms, from minibuses to double-length vehicles with pivoting centers. Rail services fall into four major categories: rapid rail (also called the underground, tube, metro or subway), which operates on exclusive rights-of-way in tunnels or on elevated tracks; streetcars (or trams), which move

with other traffic on regular streets; light rail (or trolleys), which are quieter, more modern versions of streetcars, and can run either on exclusive rights-of-way or with other traffic; and suburban or regional trains, which connect the city with surrounding areas.

The concept of public transport also includes organized car pools and van pools. For U.S. commuters in areas with inadequate bus and train service, this is the only "public" transport option. But even where bus and train systems are comprehensive, there is vast potential for car pooling; recent research shows that in cities the world over, average private car occupancies during commuting hours are between 1.2 and 1.3 persons per vehicle.[17]

Public transport modes vary in fuel use and emissions, and in the space they require—but, if carrying reasonable numbers of passengers, they all outperform one-occupant private cars on each of these counts. Energy requirements vary according to the size and design of the vehicle and how many people are on board, but buses and trains require far less fuel per passenger for each kilometer of travel. [18] (See Table 2.)

Table 2: Energy Intensity of Urban Transport Modes, United States

Mode	Number of Passengers	Energy Intensity
		(Btu per passenger-km)
Intercity rail	80	442
Intercity bus	40	477
Light rail	55	639
City bus	45	691
Rapid rail	60	752
Car pool	4	1144
Auto.nobile	1	4576

Sources: Worldwatch Institute estimates, based on Mary C. Holcomb et al., *Transportation Energy Data Book: Edition 9* (Oak Ridge, Tenn.: Oak Ridge National Laboratory, 1987); Vukan R. Vuchic, *Urban Public Transportation Systems and Technology* (Englewood Cliffs, N.J.: Prentice-Hall, 1981).

The emissions savings from public transport are even more dramatic. (See Table 3.) Since rapid rail and light rail have electric engines, pollution is measured not from the tailpipe, but the power plant (which is usually located outside the city, where air quality problems are less acute). For typical U.S. commutes, rapid rail emits 30 grams of nitrogen oxides for every 100 passenger-kilometers (that is, for every 100 kilometers each rail passenger travels), compared with 43 grams for light rail, 95 grams for transit buses, and 128 grams for single-occupant automobiles. Public transport's potential for reducing hydrocarbon and carbon monoxide emissions is even greater.[19]

Table 3: Pollution Emitted from Typical Work Commutes, United States[1]

Mode	Hydrocarbons	Carbon Monoxide	Nitrogen Oxides
	(grams per 100 passenger-kilometers)		
Rapid rail	0.2	1	30
Light rail	0.2	2	43
Transit bus	12	189	95
Van pool	22	150	24
Car pool	43	311	43
Auto[2]	130	934	128

[1]Based on national average vehicle occupancy rates.
[2]Based on one occupant per vehicle.

Source: American Public Transit Association, "Mass Transit: The Clean Air Alternative," pamphlet, Washington, D.C., 1989.

Diesel buses, especially in developing countries, are heavy polluters, though the number of cars required to carry an equivalent number of passengers would create more pollution. But the technology exists to control this exhaust. In Athens, some buses are fitted with traps to prevent particulates from being emitted into the air. Buses can also run on

"Few U.S. drivers realize that they pay about $1,700 annually just to commute to work."

less polluting fuels such as propane (used in parts of Europe) and natural gas (used in Brazil and China). Test buses in the Netherlands that run on natural gas are estimated to emit 90 percent less nitrogen oxides and 25 percent less carbon monoxide than diesel engines.[20]

In addition to reducing fuel consumption and pollution, public transport saves valuable city space. Buses and trains carry more people in each vehicle, and if they operate on their own rights-of-way, can safely run at much higher speeds; in other words, they not only take up less space but also occupy it for a shorter time. Thus, comparing ideal conditions for each mode, an underground metro can carry 70,000 passengers past a certain point in a single lane in one hour, surface rapid rail can carry up to 50,000 people, and a trolley or a bus on a separate bus lane, more than 30,000. By contrast, a lane of private cars with four occupants each can move only about 8,000 people an hour.[21]

Traveling by bus or train is also far less dangerous than by car. According to the U.S. National Safety Council, the death rate per passenger-kilometer traveled in automobiles is 7 times that for passenger trains and 97 times the rate for transit buses.[22]

The cost of providing public transport is, understandably, the overriding factor in governments' decision making. But many public officials fail to make a full accounting. A fair comparison must include a calculation of the full costs of both systems, including their environmental impacts and social consequences, and a consideration of which approach can move the most people. With public transport's lower impacts, higher capacities, and greater affordability for the general public, governments could get more for their money.

Similarly, drivers would find public transport more attractive if they kept the full costs in mind. Few U.S. drivers realize that, when the costs are factored in—including fuel, maintenance, insurance, depreciation, and finance charges (but excluding the portion of their taxes that goes toward driving subsidies)—they pay $34 per 100 miles of driving, or about $1,700 annually just to commute to work. By contrast, the average public transport fare is $14 per 100 miles. In highly car-dependent cities, a viable public transport option for commuting

could save some households from having to purchase a second or third vehicle.[23]

16 The availability and use of public transport vary widely in cities around the globe, from infrequent, near-empty buses that lumber across sprawled U.S. urban areas, to Tokyo's crowded, minute-to-minute subways, where hired "pushers" pack passengers into the train so the doors can close. Since variations in distances and city densities affect the total kilometers of travel, the annual number of trips each person takes by public transport provides a better standard for comparing its importance among various cities. The frequency of public transport use ranges from more than 700 trips annually per person in Moscow, to 22 annual trips per person in the automobile-oriented city of Dallas. [24] (SeeTable 4.)

Cities in the Soviet Union and Eastern Europe provide extensive and comprehensive public transport options, including buses, tramways, metros, and suburban trains. Although quality varies along with public spending constraints—from showpiece metros in the largest cities to undependable, overcrowded systems elsewhere—the various transport modes offer widespread service to the many people who do not own cars. Of the roughly 300 streetcar and trolley systems in the world, about 110 are in the Soviet Union and another 70 are in Eastern Europe.[25]

High-income Asian countries also make extensive use of public transport. Japanese cities are particularly rail-oriented because authorities since the sixties have primarily used commuter railroads to link expanding suburbs with urban centers. In Tokyo, 95 percent of the passenger-kilometers traveled by public transport are on trains. Metro lines in Tokyo, Seoul, and other Asian cities not only move millions of passengers within the city but also lend their tracks to through-trains from surrounding suburbs. In Hong Kong, where public transport accounts for about 9 million out of the 10 million daily passenger trips, the system is dominated by about 12,000 buses of widely varying sizes: from 14-seat minibuses to double-deckers holding 170 (the largest buses in the world, specially made for Hong Kong's situation). The city also has trolleys, ferries, taxis, and underground and surface rapid rail.[26]

Table 4: Dependence on Public Transport, Selected Cities, 1983

City	Population	Mode	Trips per Person per Year
	(millions)		
Moscow	8.0	bus, tram, metro	713
Tokyo	11.6	bus, tram, metro, rail[1]	650
East Berlin	1.2	bus, tram, metro, rail	540
Seoul	8.7	bus, metro	457
West Berlin[2]	1.9	bus, metro	389
Buenos Aires[3]	9.0	bus, metro	248
Kuala Lumpur[4]	1.0	bus, minibus	224
Toronto	2.8	bus, tram, metro	200
Nairobi	1.2	bus, minibus	151
Abidjan	1.8	bus, boat	132
Beijing	8.7	bus, metro	107
Chicago[3]	6.8	bus, metro, rail	101
Melbourne[5]	2.7	bus, tram, rail	95
Dallas[3]	1.4	bus	22

[1]In this table, 'rail' refers to suburban rail
[2]1982
[3]Metropolitan area
[4]Excludes cycle rickshaws and private minibuses
[5]1980

Sources: Worldwatch Institute estimates, based on Chris Bushell and Peter Stonham, ed., *Jane's Urban Transport Systems: Fourth Edition* (London: Jane's Publishing, 1985); Peter Newman and Jeffrey Kenworthy, *Cities and Automobile Dependence: An International Sourcebook* (Aldershot, England: Gower, 1989).

Urban public transport has long been a government priority in Western Europe. Although all major European cities contend with automobile traffic, well-developed bus and rail systems are available for those who

choose public transport. While high car ownership makes for stiff competition, public transport in large cities in Western Europe typically accounts for between 20 and 30 percent of passenger-kilometers. The Paris region is a good example of a well-integrated system of dense public transport service, with a suburban rail line within three kilometers of almost any point in the metropolitan area. There is a metro line within 600 meters of any point of the city, and the stops are even closer in the center. In recent years, several large Western European cities have stepped up their commitment to public transportation, combining further investments with complementary policies to restrict auto use.[27]

Public transport also plays an important role in urban areas of the Third World. In many cities in Asia, Latin America, and Africa, buses—in their various forms—make up 50 to 80 percent of all motorized trips. Buses are sometimes hopelessly overcrowded; it is not uncommon to see dozens of riders clinging to the sides of the vehicles. Yet most Third World cities have less public transport ridership per person than those in Western Europe, reflecting the inability of meager bus fleets to keep up with population growth.[28]

Private bus operators often take up where publicly owned systems leave off, and in many cases provide the bulk of all service. In Calcutta, for example, private companies hold roughly two-thirds of the market, and three-quarters of public transport trips in Buenos Aires are made by some 13,000 private buses, or *colectivos*. Flexible, informal forms of public transport—including minibuses, jeepneys (converted jeeps), vans, pickups, shared taxis, and cycle rickshaws—give crucial service and ply Third World cities' hard-to-get-to sections. Such vehicles account for 64 percent of road-based public transport in Manila and 93 percent in Chiang Mai, Thailand.[29]

Over the past two decades, some 21 large cities, including Mexico City, Shanghai, and Cairo, have built metro systems. These projects have greatly improved transport service in dense city centers but at great financial cost, raising widespread doubts about their economic viability in developing countries. But in several cities of such extreme density that even greatly expanded bus service cannot cope with the demand for transport, new metros are being planned despite their high cost.[30]

Developing countries' transport investments have generally favored road building over rail and public transport, and development banks' lending biases reinforced that trend. Since the World Bank first started lending to urban transport projects in 1972, there has been a distinct emphasis on roads: of the $1.8 billion lent for urban transport in the 1972-1988 period, 52 percent was spent on roads, versus 9 percent for rail; in Asian countries, roads accounted for 68 percent of spending, and public transport received only 14 percent.[31]

Among the world's major cities, those in Australia and the United States make the least use of alternatives to the private automobile. Less than 5 percent of U.S. work trips are by public transport, although large metropolises such as New York City and Chicago provide extensive service. Nearly one-quarter of the entire country's public transport trips are in New York City. But several large and medium-sized U.S. cities, having reached the limits of automobile dependence, are either building or considering light rail systems, and others are adding light rail to their existing lines.[32]

Cities in the car-infatuated state of California are leading this trend toward reviving rail transport, with projects such as an expansion of San Diego's highly successful trolley, and a light rail line in San Jose. Even Los Angeles has an extensive new rail system underway, expected to include 150 miles of light and rapid rail when completed.[33]

The recent trend in many of the world's cities is toward light rail over "heavy" rapid rail systems. Whereas metros require exclusive rights-of-way, which often means building costly and time-consuming elevated or underground lines and stations, light rail can be built on regular city streets at lower costs. The capital costs of recently constructed light rail lines ranged from $5 million per kilometer for San Diego's surface trolley to $39 million per kilometer for a tunnel light rail line in Hannover, West Germany. By contrast, the underground metro in Santiago, Chile, cost $40 million per kilometer, a metro extension in Osaka, Japan, cost $64 million, and the new underground line in Caracas, Venezuela, cost $117 million per kilometer.[34]

If elevated track is needed, light rail vehicles require smaller, less expensive structures than rapid rail. Another advantage of light rail is that,

with its lower costs, more stations can be built and placed within walking distance of other transport stops. Recent metros in Manila, the Tunisian capital Tunis, and other cities have opted for less expensive light rail technologies instead of the traditional rapid rail systems.[35]

An increasingly popular transport alternative is to upgrade old suburban rail systems, improving their speed and convenience for much less than the cost of a new metro. For example, Hong Kong completely modernized and rebuilt its suburban rail system and added new vehicles for a cost of US$13.2 million per kilometer, a little more than 10 percent of the cost of the city's underground Island Line. Rail upgrading projects are now underway in at least 50 major cities, including London, Jakarta, Melbourne, and São Paulo. Whereas the emphasis of suburban rail used to be on radial routes to the city center, it now often encompasses suburb-to-suburb trips and journeys across the city.[36]

Preventing transportation crises in the 21st century requires a full commitment to public transport. Particularly in the dense centers of the developing world, as exponential growth continues and environmental constraints tighten, the need for rail systems that can move the greatest number of people using the least space and fuel will become even more acute.

Cities for People

Walking and cycling are the most common forms of individual transport. Because they are economical and clean, save space, and require no fuel other than a person's most recent meal, walking and cycling are the most appropriate ways to make short trips. Yet nonmotorized transport is often ignored as part of transport systems. Few cities, if any, adequately address the needs of pedestrians and cyclists.

In both rich and poor countries, serving the needs of people who don't have cars is crucial for creating a sustainable transport system. There are several ways to make cities for people, not just for cars. Among them are providing various facilities to improve cyclists' and pedestri-

"For cycling and walking to be viable means of transport, people must be able to move safely throughout the city without a motor."

ans' access to points throughout the city, giving pedestrians and cyclists priority in city centers, and integrating cycling and walking with public transport.

More than half of all U.S. work trips and nearly three-fourths of those in the United Kingdom are eight kilometers or less—and commutes in more densely developed settings are even shorter—but people prefer to drive rather than face dangerous streets without the protection of a motor vehicle. In Third World cities, where most people have no choice but to walk or cycle, the few people who drive are allowed to dominate the streets.[37]

The most effective way to make cities safer and more convenient for walking and cycling is to keep motor traffic from commandeering urban space. Because of their mass and speed, cars automatically take over streets, intimidating and endangering people on foot or on bicycles. For cycling and walking to be viable means of transport, people must be able to move safely throughout the city without a motor. Ensuring that pedestrians and cyclists have a continuous route to their destination calls for separate lanes and paths in some situations (where motor traffic is heavy and traveling quickly), but more often, it requires making motor vehicles share regular streets with slower traffic.

It takes active restrictions on automobiles to make some streets safe for slower traffic. Particularly on residential streets, making cars slow down with speed limits and physical barriers can discourage drivers from "rat running"—racing down side streets to avoid congested intersections and delays on larger roads. Many European cities use these restrictions, known as "traffic calming," to turn streets into places for people who live, work, and shop there, instead of for drivers just passing through. While there is so far no evidence that traffic calming reduces overall automobile use, the schemes' chief contribution is to safely accommodate pedestrians and cyclists on city streets without shunting them onto separate (and often inferior) lanes or paths.

For more than two decades the Dutch have calmed traffic by changing the layout of the residential street, transforming it into a *woonerf*, or "living yard." In the *woonerf*, cars are forced to negotiate slowly around

carefully-placed trees and other landscaping. Since motor traffic cannot monopolize the entire breadth of the street, much of the space is made more open to walking, cycling, and children's play. Automobiles are free to enter the *woonerf*, but only as "guests," while nonmotorized traffic has priority. Experience with traffic calming has shown that it is most effective if widely implemented, so that motor traffic problems are not simply diverted to nearby streets.[38]

West Germany's similar *Verkehrsberuhigung* ("traffic calming") schemes have multiplied into the thousands throughout the country since they were started in the seventies. Originally intended for residential areas, *Verkehrsberuhigung* is now spreading over whole cities. Traffic calming greatly improves the quality of life in neighborhoods where it is implemented, and so is gathering popularity in many countries, including Sweden, Italy, Switzerland, and Japan. Such restraints are so well-received in Denmark that local residents themselves are often willing to pay for the measures.[39]

West German cities are also using speed limits to slow down cars on urban streets. A five-year experiment designating thousands of such streets nationwide as "Tempo 30," or a 30-kilometer-per-hour speed limit, and nearby busier thoroughfares as Tempo 50, has shown encouraging results. Tempo 30 zones showed significant reductions in accident rates and noise and exhaust levels, with no increase in speeds or accidents on nearby major roads. As with traffic calming, Tempo 30 has proven most effective where applied to entire zones rather than single streets, and where public transport is exempted and given right-of-way. Following the end of the experiment in 1989, demands for Tempo 30 arose from all over the country, and now there is talk of introducing it on 60 to 70 percent of city streets nationwide.[40]

Another way to give street space to people other than drivers is to restrict cars in city centers, where they are the least appropriate and most bothersome form of transport. Several Western European cities have successfully restrained traffic in the core by dividing it into cells. In Göteborg, Sweden, for example, the city center is divided into five pie-shaped zones, all accessible by a large ring road on the periphery. Automobiles may not cross the zone boundaries, but public transport,

emergency vehicles, bicycles, and mopeds can. Göteborg's cell system was instituted in 1970 along with reserved lanes for buses and trams, and some streets closed to all but pedestrians. Since then, the city has had fewer accidents and better public transport service. Traffic cells are also found in Bremen, West Germany (where they originated); Besançon, France; the Dutch city of Groningen; and Tunis.[41]

Making bicycling practical also depends on creating continuous routes throughout the city so that cyclists can safely get from one point to another. This may require separate lanes and paths for cyclists. But simply providing separation is not enough; traffic planners need to analyze data on movement patterns and accident potential when designing such paths. And they should require bicycle paths to be sufficiently wide and smooth—otherwise, the paths create safety hazards.

Where separate lanes or paths for nonmotorized traffic are necessary, the trick is to avoid using them to restrict pedestrians and cyclists from regular streets. In the Netherlands, where some 30 percent of work trips and 60 percent of school trips are made by bicycle, some cities have combined separate paths and traffic measures on regular roads to create direct, uninterrupted bicycle routes, rather than to keep cyclists out of the way of drivers. Chinese cities often provide exclusive pedestrian/cyclist lanes and bridges for the country's 300 million cyclists, and various turning restrictions on motor traffic at dangerous junctions.[42]

The most dangerous situations arise at intersections where nonmotorized traffic and motor vehicles cross paths. Some cities provide separate overpasses and underpasses for nonmotorized traffic at such junctions. But what many cities call "safety improvements" often mean overhead skywalks, isolated bikepaths, and other physical schemes that merely clear children, cyclists, and pedestrians from space meant to be the sole domain of cars. Sometimes these separate facilities are necessary, but it is usually preferable to restrain the motor traffic so that people can cross safely. This can be done with special traffic lights, for example, or by designating space for cyclists to stop ahead of cars at an intersection, together with a light that allows them to proceed first.[43]

Another effective way to make streets more amenable to pedestrians and cyclists is to restrict car parking downtown. Such restrictions not only free space for nonmotorized traffic but also encourage people to choose transport options other than driving. Paris Mayor Jacques Chirac, apparently impressed by the reduced traffic resulting from temporary parking restrictions for France's 1989 bicentennial, announced plans to permanently remove more than 100,000 street parking spaces in central Paris to make space for public transport and pedestrians. Unlike many cities in the United States, West Germany, and the United Kingdom, which require employers and developers to provide parking at their sites, Geneva prohibits car parking at workplaces in the central city, motivating commuters to use the city's excellent public transport system.[44]

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Belying conventional wisdom, research in 10 major German cities has shown that parking spaces do not always attract more shoppers to commercial areas. In fact, too much parking can even hurt business by creating an atmosphere unfriendly to pedestrians. Bicycle parking is much less expensive to provide and brings in quieter, safer, nonpolluting traffic.[45]

Copenhagen's city council has reduced car traffic in the city center by banning all on-street parking in the core, replacing parking space in public squares with landscaping, and increasing the amount of bicycle parking at commuter train stations. Public policy in Harare, Zimbabwe, requires merchants to provide bike parking downtown. Although bicycle parking is relatively simple to supply, it must be designed carefully to be secure. High theft rates naturally deter potential cyclists. Perhaps the most effective security measure is guarded bicycle parking, common in many Asian countries, including China and Vietnam, and at rail stations in industrial countries, including Japan, the Netherlands, West Germany, and Denmark.[46]

City centers benefit greatly from the creation of automobile-free pedestrian zones. Nearly all major European cities have devoted at least part of their centers to people on foot. Munich's impressive 85,000-square-meter pedestrian zone owes much of its success to easy access via convenient public transport services. Catering to pedestrians is more important to commerce than is often recognized; a survey of changes

"Parking spaces do not always attract more shoppers to commercial areas. In fact, too much parking can even hurt business."

after pedestrian zones were created in the United States, the United Kingdom, and West Germany showed that local sales generally increased by 25 percent or more. Third World cities with heavy concentrations of foot traffic and street vendors could enhance safety and improve traffic conditions with such schemes. After pedestrian streets were established in Lima, Peru, attracting both street traders and shoppers on foot, traffic flow through the center improved dramatically.[47]

While cycling and walking are often used for short journeys, they can satisfy a much larger share of urban transport needs if integrated well with trains and buses. This requires safe access to transit stops and stations for people arriving on foot or by bicycle. In some cases separate paths may be necessary, although restraining motor traffic in the vicinity of stations is often sufficient. Rail station entrances can also be made more accessible to passengers who do not arrive by car through the strategic placement of bicycle parking, bus lanes, and car parking. For example, a Dutch national railway program seeks to give the highest priority at station entrances to pedestrians, followed in descending order by bicyclists, bus riders, taxi passengers, people dropped off by car, and finally, those who park a car at the station.[48]

"Bike-and-ride" facilities, which encourage commuters to cycle to rail stations instead of drive, are increasingly popular in Japan and Western Europe. For years Japanese commuters have preferred bicycles over slow feeder buses for getting to suburban rail stations. Japan's 1980 census figures showed that 7.2 million commuters, or about 15 percent of the total, rode bicycles to work or to commuter rail stations. In Europe, the portion of railway passengers in suburbs and smaller towns who bicycle to the station varies from 10 to 55 percent. Stations often have spaces for hundreds of bicycles, and many public transport systems allow cyclists to bring their bikes on the bus or train.[49]

Bike-and-ride programs have several advantages over car parking. For a small fraction of the cost of providing additional automobile parking (which requires at least 20 times as much space as bicycle parking), transit authorities can increase non-auto access to stations by a radius of up to 3 kilometers, enabling more non-driving passengers to use public transport. Allowing bicycles onboard trains gives commuters easy access at both ends

of the trip, even if neither the commuter's home nor workplace is within walking distance of a station. This removes a major constraint on the use of suburban rail for commuting, since for many commuters, either the home or workplace may be beyond walking distance of the rail station.[50]

For many people in developing countries, nonmotorized travel is essential because auto ownership is out of the question. Motorcycles and mopeds are increasingly popular in much of the developing world, but in addition to being heavily polluting, they are too costly for those with low incomes and require expensive, scarce fossil fuels. Even buses are out of reach for many; it is estimated that one-fourth of households in Third World cities cannot afford public transport. For those who can, it typically requires 10 to 15 percent of their income.[51]

Governments that are overwhelmed by the costs of expanding public transport can greatly improve people's travel options for less investment by subsidizing bicycle purchases. In countries such as Tanzania, where a bike costs as much as seven or eight times the average monthy wage, cycling can be an unaffordable luxury. Some city governments in China have relieved pressure on overcrowded buses by paying commuters a monthly allowance for cycling to work. Credit schemes to help people buy bicycles, rickshaws, and other nonmotorized vehicles are in place in India, Ghana, and other countries, and city employees in Harare receive low-cost loans for buying bicycles.[52]

Cities can thus address many of their transportation problems by facilitating cycling and walking—from displacing car travel for short trips, to making public transport more convenient, to providing high-quality mobility and accessibility to people for a fraction of the cost of motorized transport. Beyond these benefits, the quality of life improves in cities that are oriented to nonmotorized transport, not just automobiles.

The Road Not Taken

A city's potential to expand public transport and facilitate cycling and walking depends on much more than providing buses, trains, and safe streets. The layout of a city helps determine whether or not these trans-

port options are appropriate or even feasible. Many urban areas are designed around the automobile, with planners using road building to combat the inevitable traffic congestion. The result is a treadmill effect in which new roads fill to capacity as soon as they are completed, and cities begin to look like Los Angeles, where two-thirds of urban space is paved over for cars.[53]

Instead of further catering to autos, cities can step off the road building treadmill by changing land use patterns to reduce the need for driving. For the long haul, reducing automobile dependence calls for a fundamental rethinking of the very shape of cities.

Although all major urban areas struggle with traffic congestion to some degree, those with the least sprawl are most able to promote alternatives to driving. In their study of 32 of the world's major cities, Australian researchers Peter Newman and Jeffrey Kenworthy found that low urban densities (fewer than 40 people and jobs per hectare of land) and dependence on the automobile go hand-in-hand. Sprawling cities in the United States and Australia are highly automobile-oriented, medium-density cities in Western Europe and Canada have greater use of public transport, and highly concentrated metropolises in Asia have more commuters who walk and cycle. (See Table 5.) In Phoenix, for example, which has an extremely low density, 93 percent of workers commute by private car. Stockholm, which is six times more compact than Phoenix, is far more reliant on other forms of transport; only 34 percent of workers there commute by car. While low automobile use generally means more reliance on public transport, in the densest cities it also reflects more cycling and walking.[54]

Newman, Kenworthy, and other researchers have concluded that strong land use policies to increase urban densities are crucial in fostering viable alternatives to automobile dependence. Very high densities are not necessary; even moderate densities of 60 to 100 people and jobs per hectare, typical of many European capitals, can greatly enhance travel options. The difference that land use controls make is striking when development patterns in Japan or Western Europe, which have strict regulations encouraging compact development, are compared

Table 5: Urban Densities and Commuting Choices, Selected Cities, 1980

City	Land Use Intensity	Private Car	Public Transport	Walking and Cycling
	(pop. +jobs/ha)		(percent of workers using)	
Phoenix	13	93	3	3
Perth	15	84	12	4
Washington	21	81	14	5
Sydney	25	65	30	5
Toronto	59	63	31	6
Hamburg	66	44	41	15
Amsterdam	74	58	14	28
Stockholm	85	34	46	20
Munich	91	38	42	20
Vienna	111	40	45	15
Tokyo	171	16	59	25
Hong Kong	403	3	62	35

Source: Peter Newman and Jeffrey Kenworthy, *Cities and Automobile Dependence: An International Sourcebook* (Aldershot, England: Gower, 1989).

with those in the United States or Australia, where loose planning has promoted sprawled suburban growth. Urban densities in Germany, for example, are twice as high as those in the United States, and in most European cities a greater share of urban residents live in the center of cities instead of the periphery. Even Europe's suburbs are more concentrated than those in the United States and Australia, and they are nearly always provided with public transport.[55]

While many cities have evolved compactly because of clear constraints on space, others with plenty of available land have purposely contained sprawl in the interest of efficiency. Sweden's cities—compact centers surrounded by vast stretches of rural, largely forested land—demon-

strate the success of the country's strong urban land use policies. The Soviet Union also makes efficient use of urban space despite its great size.[56]

European governments have long recognized the need to let societal gain, and not individual profit, determine how urban space will be used. Columbia University professor Kenneth Jackson cites the example of a large West German city: "When truck farmers tend their crops within 2,000 yards of the skyscrapers of Düsseldorf, the richest city on the continent, [it is] not because alternative land uses would not yield a higher return, but because the government rejects the very possibility of development". In much of Europe, development of private land is guided by zoning, tax incentives, bans on low-density projects, and other measures. Urban planners try to position new developments within cycling or walking distance of public transport stops.[57]

Although the term "high density" evokes images of towering apartment buildings and little open space, dense developments are pleasant and livable if planned well. A more compact urban form, far from precluding green spaces and structures on a human scale, can actually facilitate them. The planned Mission Bay development in San Francisco, for example, will combine homes and offices with ample open space at a total density higher than many large Western European cities—all with no buildings higher than eight stories. According to a study done for the U.S. Environmental Protection Agency, a compact development can mix two- to six-story apartments and town houses with clustered single-family homes, and still leave 30 percent of the developed area for open space and parks. In a typical low-density sprawl community, according to the study, only 9 percent of the land is devoted to open space.[58]

Land use controls, more than simply increasing density, ideally should mix different land uses. Zoning can be used to foster a mix of homes and commercial uses instead of separating them and thus creating long commutes. University of California researcher Robert Cervero points out that in the developed world there is no longer a strong case for separating homes from jobs, because today's workplaces are not the smokestack factories and slaughterhouses of the industrial era. The

original purpose of separating the two was to prevent nuisances springing from proximity, but today, according to Cervero, "...the `nuisance' facing most suburban areas seems...more one of traffic congestion."[59]

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Stockholm is a good example of a decades-old scheme to mix land uses and integrate development with transport. The capital is ringed with satellite communities of 25,000 to 50,000 people each, linked closely with a rail network and expressway. Shops, apartments, and offices are clustered around train stations that give people access to jobs on the periphery and in the center. The plan has also allowed city officials to restrict driving and parking downtown and make the center more amenable to walking and cycling. Paris has followed similar development policies.[60]

Zoning changes could help offset the common problem of imbalance between jobs and housing, a major contributor to automobile dependence. Since developers often prefer more profitable office and retail projects over housing, and cities and suburbs want to expand their tax base by attracting corporate investments, housing gets shunted elsewhere, creating long commutes, or neglected entirely. Without development controls, job centers are not likely to be interspersed with affordable housing because it is less profitable to developers.[61]

Such controls include strong pro-residential policies in the city center, for example, tying office space development to a required minimum amount of space for homes. An alternative is to levy fees on developers whose projects will worsen the imbalance, and use the revenues to create jobs in job-poor areas and housing in housing-poor areas. The Southern California Association of Government's Regional Mobility Plan, a 20-year undertaking launched in 1990 to address the region's transport problems, is considering using this strategy to improve its balance of jobs and housing.[62]

It is not too late for well-established cities to change their auto-oriented land use patterns, as Toronto and other Canadian cities have shown. Toronto has used zoning and incentives for developers to concentrate projects in certain areas and near subway stops. Half of all apartments built since 1954 in Toronto are within walking distance of rapid rail

"Zoning changes could help offset the common problem of imbalance between jobs and housing, a major contributor to automobile dependence."

transport, and 90 percent of all new offices are adjacent to stations downtown and at three other locations. In the morning rush hour, 77 percent of downtown workers commute by public transport. Toronto has grown so quickly (the population doubled during the period of subway construction) that in the eighties local residents began to protest further growth. Recent land use plans place limits on development in the center and use newer rail lines to help divert development out to subcenters. Unfortunately, spending on the rapid rail system has also dropped to roughly one-fourth the level of the sixties and seventies, threatening to set back Toronto's widely acclaimed progress in transport service.[63]

Toronto's experience shows that auto dependence can be lessened by combining public transport expansion with planned land use to create higher densities and shorter travel distances. Juri Pill, general manager of administration and planning at the Toronto Transit Commission, describes the city as "a compact, transit-oriented...centre of the region, surrounded by highway-oriented urban sprawl modelled on U.S. cities: Vienna surrounded by Phoenix." Today, Toronto's overall density is comparable to several major Western European cities, and, despite increasing auto ownership, public transport ridership has increased 80 percent in a little more than two decades.[64]

The rapid rail system seems to have shaped metropolitan Toronto: viewed from an airplane, the rail stations are clearly marked by the dense clusters of development around them. But more precisely, the successes of both the transport system and the related land developments have been mutually reinforcing. Rail can be an important force in urban development in Toronto and elsewhere, but in the absence of specific land use policies, a new rail line by itself will not induce high density. Similarly, its impact is greatest in an economically healthy urban environment; under conditions of decline, rail is not likely to attract development. In Paris, Stockholm, Hamburg, and many other cities, rail systems and deliberate land use controls have created compact, efficient developments.[65]

Even cities in Australia and the United States are beginning to rethink their inefficient use of land. Portland, Oregon, decided to use some federal road building funds to build a light rail system instead, and worked

out plans to intensify development along the rail corridor. The city intends to use revenues from joint development projects (such as leasing air rights over stations to private developers) to make the light rail line self-sufficient. Portland is encouraging multi-family housing in low-density areas, and emphasizing housing in the city center. City officials also are restricting downtown parking and giving traffic priority to both the light rail and some bus routes.[66]

The time may be ripe for more careful development in other parts of the United States. In a public opinion poll of New Jersey residents, 25 percent of the respondents said development controls should be "very strict" and 50 percent said "extremely strict". However, many popular no-growth initiatives actually undermine the goals of mixing land use and concentrating higher densities near public transport, by trying to stop growth altogether. This just diverts inevitable development to areas where the controls are looser, leading to further sprawl. The issue is not whether to reject or accept growth, but rather how best to use it to reduce automobile dependence and make communities more livable.[67]

Housing and taxation policies can either support or undermine land use controls and transportation improvements. For example, suburbanization in the United States has been fueled largely by the subsidy of single-family homes through property tax and mortgage interest deductions from federal taxes. Canadians and Western Europeans, who generally do not receive such benefits, tend to live in denser multi-family housing. Tax codes that favor new construction over improvements to existing buildings also encourage sprawl.[68]

Land use controls have had relatively little success in developing countries because of rapid growth, lax enforcement, and inability to meet regulations, among other obstacles. Particularly in Asian cities, high densities already overwhelm the public transport systems. Yet since so few people have automobiles, it is important for urban distances to be on a walking or cycling scale. Hong Kong, Seoul, and Singapore have helped manage travel demand by drawing development into designated subcenters outside their cores. Singapore's plan used an extensive low-income housing program to place jobs and homes within short distances, partially relieving downtown congestion without expanding the transport system.[69]

"The issue is not whether to reject or accept growth, but rather how best to use it to reduce automobile dependence and make communities more livable."

In Pakistan, Karachi's "Metroville" program for urban development operates on a similar principle. The plan enables people to build their own homes within walking distance of jobs, and eliminates some commutes by promoting home-based workshops for producing textiles, furniture, and other goods. In Africa and Latin America, similar schemes that plan urban development to bring together jobs, services, and affordable housing hold great potential for solving city-wide transport problems and giving people access to vital amenities.[70]

Cities can use transport improvements to expand employment and attract new capital by enhancing access to potentially developable areas. For example, public transport is extremely valuable to retailers. Rapid rail systems can attract these and other types of businesses, relieving workers of the daily ordeal of driving in heavy traffic. Filling in low-density cities has major economic benefits; over the long run, a growing population helps to revitalize a city center. Particularly in the poverty-ridden, decaying centers of large U.S. cities, it is crucial to plan land use and transportation improvements for low-income residents, and to locate affordable housing with easy access to jobs.[71]

Cities can easily lose jobs because of congested, overwrought auto commutes. But they stand to gain economically from a long-term commitment to public transport and careful land use planning. Downtown space can be put to far more productive use than automobile parking; Newman and Kenworthy's study of density demonstrates that, based on automobile access, a city's center can typically accommodate a maximum of roughly 120,000 jobs. Beyond that point, existing structures would have to be razed to make way for additional parking and road space. Basing access to the center on public transport, cycling, and walking, by contrast, allows a city to grow while remaining attractive and livable.[72]

A Policy Overhaul

Automobile dependence plagues the world's major cities with problems that further tinkering with car technology will never solve. To fully confront congestion, pollution, oil dependence, and increasingly unlivable cities, governments will need to end the reign of the automo-

bile by performing a policy overhaul. The surest way to lessen overdependence on cars is through a wholesale reordering of transportation priorities.

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The first step is to bring to light the hidden costs of driving, such as air pollution, municipal services, and road construction and repair. Perhaps least-recognized of these expenses are items such as police, fire, and ambulance services. According to an analysis of the salaries and personnel time of the Pasadena Police Department in California, 40 percent of department costs are automobile-related; primarily accidents, thefts, and traffic control. Extending this finding to the entire United States suggests that driving costs local governments alone at least $60 billion each year. Only when such hidden costs are acknowledged will governments recognize that transportation alternatives are economical.[73]

Employer-provided parking represents an even more direct subsidy of driving. In the United States, where fewer than 10 percent of employees pay for parking, employers can deduct the expense of providing parking from their taxes. However, deductions for public transport fare reimbursements are strictly limited. Employees receive parking as a tax-free fringe benefit, worth an estimated $12 billion to $50 billion a year nationwide.[74]

Tax benefits for company cars are another common subsidy. Light taxation of company cars in Great Britain, for example, diverts some $5 billion annually from the public treasury, and encourages more driving and purchase of less fuel-efficient cars. Company cars on average log nearly twice as many miles per week as household cars, mostly for private purposes. In response to growing public ire over this subsidy, taxes on company cars have been hiked each year since 1988—provoking vehement protests from the auto industry. The subsidy is still sizable, however, and needs further reduction.[75]

So long as automobile owners are showered with these inducements, they will stay in their cars and leave trains, buses, and bike paths empty. This creates a vicious cycle, since transport planners are unlikely to invest in improved alternative transport when existing systems are

underused. The key to breaking out of this cycle is to make drivers pay more of the true costs of auto use.

Removing parking, for example, discourages the one-person-per-auto commute. In April 1975, when Canada began charging federal employees 70 percent of the commercial rate for parking, the number driving alone to work dropped 21 percent and commuting by public transport increased 16 percent. In a study of workers commuting to Los Angeles' Civic Center, employees who paid for their parking were 44 percent less likely to commute alone and 175 percent more likely to use public transport than their colleagues who parked for free.[76]

A reasonably high gasoline tax, such as the $1 to $2 per gallon taxes now common in Europe, would discourage driving, encourage people to use public transport where it is available, and raise revenues to expand transit service where needed. Such gasoline taxes would also serve as a steadying influence on widely varying petroleum prices. Particularly in the United States and Canada, where gasoline prices are comparatively low, steady increases in gasoline taxes are needed during the next decade.[77]

It also makes sense to levy a sizable tax on new cars and raise annual registration fees. Such charges encourage people to consider the full costs of driving when they purchase a car, and serve as a disincentive for households to purchase a second or third automobile. One approach is the new German policy of tying these fees to a car's emissions of pollutants. Another is to base the tax on the car's fuel economy.[78]

If driving became more expensive, people would demand investments in transport alternatives. This would help counter the large and powerful automobile lobbies made up of oil companies, car makers, highway builders, and other interests. Given the gross imbalance in many cities' transport systems, it makes sense to dedicate some of the revenues from automobile-related fees and taxes to the development of pedestrian and cycling facilities and public transportation. Indeed, without sizable and sustained government funding, the needed alternative transport infrastructure will be slow in coming.

Creating a sustainable transportation system hinges largely on making the alternatives attractive. Surveys show that even U.S. drivers choose to drive not out of blind love for cars but rather from consideration of the time and money required for a trip. Because people base their transportation choices on the cost, convenience, time, and dependability of their options, making the alternatives convenient helps cities achieve a better transport balance.[79]

Local governments' new priorities would make trains, trolleys, and buses the backbone of urban transport systems, with automobiles as an alternative for limited uses. Transit service should be reliable for off-peak as well as commuting trips. Drivers will only use public transport regularly if the standard of service is high and the systems are convenient; aiming to attract these riders creates a more effective system than one that only serves carless citizens. Paris, Hamburg, Copenhagen, Tokyo, Toronto, and other cities have shown that such a strategy can boost ridership markedly.[80]

Strengthening some parts of a transit system can also benefit other parts. For example, trains can enhance the status of public transport in a city because they have a strong identity and attract many riders. A major study of rapid rail and light rail in the United States found that municipalities with rail systems had the same or higher bus use per capita than cities with bus services only, suggesting that the high visibility of rail services increases total public transport usage.[81]

Municipalities can share the cost of expanding transport services by striking deals with private land developers who benefit from enhanced access to their projects. Joint development schemes can be planned at new metro stations, helping to defray costs. The Metropolitan Area Transit Authority of Washington, D.C., has estimated that the long-term benefits of joint development projects at just two metro stations will exceed public costs by more than $200 million.[82]

A mix of public and private participation in bus and train services can increase efficiency and take financial pressure off city governments—so long as the public sector remains a principal provider, and also plays a strong regulatory role. Throughout Asia, Latin America, and Africa,

"Expanding and improving the rail option can help ease highway and airport congestion for a small fraction of the cost of building new highways and airports."

privately run minibuses and minivans help fill the public transport gap where government services alone cannot meet the demand. But such arrangements require careful regulation to ensure that both profitable and unprofitable routes are covered, fares are reasonable, and safety standards are enforced.

In densely developed corridors, passenger rail systems deserve funding priority over highways—for efficient intercity transport of both passengers and goods. In industrial countries, expanding and improving the rail option can help ease highway and airport congestion for a small fraction of the cost of building new highways and airports. In much of the developing world, rail lines that have been allowed to deteriorate can be revived. It would not be unreasonable to require large foreign companies that place high demands on rail in developing countries to shoulder part of the financial burden for improving the system.[83]

Eastern Europe and the Soviet Union are uniquely positioned, with extensive public transport systems, to avoid the excesses of auto dependence— even though the near future will bring a flood of opportunities to repeat Western industrial countries' mistakes. There is ample argument for these governments to focus future transport investments on improving the often-inadequate quality of transit service, and structure auto costs to accurately reflect their environmental and social impacts.

In developing countries, the deterioration of public transport systems and the neglect of nonmotorized transport are largely the result of lending biases among international development banks, which favor road building. Although the rationale for emphasizing motorization has been to transport goods and thus boost economic development, this strategy has created unbalanced transportation systems that leave those who cannot afford cars with severely inadequate transportation.

The extent of developing countries' unmet transport needs and their overwhelming financial debt make it clear that an automobile-dominated future is not viable for the Third World. This argues strongly for an international effort to help developing countries finance public transport projects— particularly rail expansion, where appropriate —through increased taxes on fuel, automobile manufacture, or related items. Such

a move would only partially compensate for the industrial countries' disproportionate share of world oil consumption, as well as their responsibility for global warming and other environmental problems.[84]

Cities that are building public transport systems from scratch would do well to begin with bus shuttles to major employment and shopping centers, campuses, and other common destinations. Dedicated lanes for buses would speed service, helping to attract more passengers where demand is low and greatly improving efficiency where demand is high. Another intermediate step toward public transport is to encourage car pools and van pools by reserving some lanes solely for vehicles with three or more occupants.

Charging drivers for the right to use congested roads is a further incentive for ride sharing. Since 1975, Singapore has successfully used an "Area Licensing Scheme," levying a fee on vehicles entering the city center— except for buses, commercial trucks, and cars carrying four or more people. The scheme is part of a package of traffic measures, including expanded bus service, heavy parking charges, and high car taxes, that have reduced congestion and traffic accidents, and helped avoid further road building.

With the right incentives, employers may prove the best promoters of public transport. Local governments can require large employers to provide bus and train route information and offer financial bonuses to employees to promote ride sharing, use of public transport, and cycling and walking. In Southern California, for example, the South Coast Air Quality Management Plan requires businesses employing more than 100 people to submit plans for reducing one-person-per-car commuting; employers who do not comply face stiff fines.

Effective land use planning is another key to a viable new transportation system. Several studies suggest that there is a threshold level of urban density—30 to 40 people per hectare—below which reliance on the automobile soars. This is about the density level found in Copenhagen, Toronto, and Hamburg. Comparing Copenhagen (30 people per hectare) with Denver (12 people per hectare), it appears that a 60 percent decrease in density corresponds with a 285 percent increase in gasoline use per person. This dramatizes the difference relatively

moderate land use changes can make, and provides a practical minimum density that planners can use as a guide.[87]

It is important for local land use policies to be made to fit into more comprehensive regional plans. Otherwise, communities may solve their own transport problems—particularly congestion—at the expense of neighboring areas. The experience of fragmented local planning boards in the United States has also shown that without broader coordination, private developers can play one body off another and so escape controls.[88]

Particularly in the developing world, allotting street space logically and efficiently would mean setting aside exclusive space for buses and giving pedestrians and cyclists priority over automobiles. In all cities, local authorities can promote alternative transport with ordinances that require buildings and developments to provide secure bicycle parking and convenient access to main entrances for people who arrive on foot, by bicycle, or by public transport.

Newman and Kenworthy have noted that automobile parking is almost a "litmus test" of a city's car orientation. Their 32-city study found that generally there were 150 to 200 parking spaces per 1,000 jobs in the central business district; but in the most auto-dependent cities there were more than 500 parking spaces per 1,000 jobs. The researchers suggest that these extremely auto-dependent cities should set a limit of no more than 200 parking spaces per 1,000 jobs in the central business district.[89]

What would the future look like, if cities were not dominated by cars? The very heart of a city would be reserved for people on foot and passengers arriving by metro or trolley. Proceeding outward from the center, streets would become the shared domain of pedestrians, cyclists, trolleys, and buses. Slow automobile traffic would be allowed beyond the city's densest core, but convenient bus and rail services—running between stops placed within walking or cycling distance of most points—would offer a faster mode of travel. Express public transport routes would link outlying areas to each other and to the downtown. Car parking would be progressively less restricted as one moved away from the city center.

People would make most short trips by foot or bicycle, and longer urban trips by walking or biking to transport stops, then continuing by bus, metro, or trolley. Many long drives and short airplane flights between cities would be replaced by train trips. Automobiles' main function would be to make trips for which these other modes are inconvenient, such as transporting loads of things or groups of people, traveling at odd hours when public transport is running infrequently, and certain recreational uses.

The challenge of creating an alternative transport future is ultimately a political one. As elected officials in most societies are well aware, many people continue to support the policies that have nurtured overreliance on cars—from driving subsidies, to tax benefits, to expansion of parking lots and roads. Even more resistance to change lies in the colossal power of the automobile and road lobby.

However, as the enormous problems caused by excessive dependence on the automobile continue to plague cities, a political transformation may occur. Indeed, citizens in many nations are beginning to see that the costs of automobile dependence are already outweighing the benefits. If cities are to achieve the dream of clean, efficient, reliable transportation once promised by the automobile, they will have to steer instead toward sustainable alternatives.

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